DOCUMENT RESUME

ED 152 324 IR 005 867

TITLE Australian Society of Educational Technology Yearbook, 1977.
INSTITUTION Australian Society of Educational Technology, Adelaide, South Australia.
PUB DATE 77
NOTE 90p.; For related document, see IR 005 866
AVAILABLE FROM The Editor, ASET Yearbook, Advisory Centre for University Education, University of Adelaide, Adelaide, South Australia 5000 ($2.00)

EDRS PRICE MF-$0.83 HC-$4.67 Plus Postage.
DESCRIPTORS *Educational Technology; *Educational Television; Instructional Design; *Literature Reviews; *Medical Education; Simulation; *Speech Compression; *Universities; Yearbooks

ABSTRACT

This yearbook contains reports from the presidents of the two chapters of the Australian Society of Educational Technology and six articles: Educational Technology at the Tertiary Level; Simulation in Medical Education; Ten Years in Educational Television; Rate Controlled Speech--A Review; Educational Technology--A Discussion of Selected Journal Literature 1976-1977; and Educational Television Systems--A Guide. (DAG)

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YEAR BOOK

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AUSTRALIAN SOCIETY OF EDUCATIONAL TECHNOLOGY

YEARBOOK 1977

Edited by Robert A. Cannon

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Individual contributors and the Australian Society of Educational Technology

ISSN 0313-4202

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Cover design by Roger Trethewey and Colin Lambert

AUSTRALIAN
SOCIETY OF
EDUCATIONAL
TECHNOLOGY

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PRESIDENTIAL REPORTS

South Australian Chapter

The Australian Society of Educational Technology is three years old. Like any moderately healthy three year old, we are entering a critical period in which we must increasingly concern ourselves not only with our own survival, but also with our relationship to others around us. In particular, we will need to carry out an honest appraisal of our growth here in South Australia and to seek a strengthening of links with interested groups in other States.

One of the most significant developments in the brief history of the Society was initiated by a group of interested people in Melbourne. They enquired about the possibility of forming a Victorian chapter. After a number of lengthy meetings between Council members and representatives of the Victorian group, Council proposed extensive revision of our Constitution to establish State Chapters as the vital functional units of the Society with a National Council having merely an advisory and co-ordinating role. These proposals were accepted unanimously by members at the 1977 Annual General Meeting and we have since been pleased to hear that the formation of the Victorian Chapter has taken place. Considerable interest in forming State chapters has also been expressed in other States, so we are encouraged that the National character of the Society is taking on new dimensions.

Another important development that has occurred is the increasing participation of the Society in joint ventures with other organizations. In particular, combined meetings with the Library Association of Australia and a joint conference with the South Australian Education Department's Educational Technology Centre occurred this year.

At present, the South Australian Chapter has more than seventy members representing various aspects of primary, secondary and tertiary education. Membership includes lecturers, classroom teachers, subject specialists, educational technology consultants, librarians and administrators. We also have a number of members from areas outside formal education - such as from industry and training. In 1976, we conducted eight general meetings covering such topics as Educational Games and Simulations, Training for Industry and Commerce, Video Production Techniques and Curriculum Evaluation. One of the highlights of that year's activities was a seminar entitled "The Book and the Media" held at Kilkenny Multi-Media Centre. This seminar featured Mr. Colin Thiele, the prominent educator and author, and Mr. Bill Davies, who has had wide experience in the management of radio, television and the press. The meeting was videotaped and copies of the tape can be made for any individuals or educational institutions who request them.

I would like to pay tribute to an extremely loyal and hard working Council. In particular, I thank Robert Miller, Secretary, and Robert Cannon, Treasurer, for the countless hours they have so enthusiastically given to keep the Society in operation. Robert Cannon has also acted as editor for both our Yearbook and Newsletter. The importance of these publications has become increasingly clear as interest in the Society has widened and extended beyond the borders of South Australia.

We look forward, with confidence, to a continuing increase in interest in educational technology at all levels in the community and to a consolidation of the Australian Society of Educational Technology as a national professional body.

Deane W. Hutton
President

Victorian Chapter

On the evening of June 2nd, 1977, at the State College of Victoria, Toorak, more than one hundred people gathered at a public meeting called to inaugurate the Victorian Chapter of the Australian Society of Educational Technology. After a somewhat lengthy and complicated election - there were twenty seven nominations for only ten Council vacancies - an Interim Council was appointed and the Chapter had come into existence.

That event climaxed eleven months of meetings, negotiations and planning. The Victorian Steering Committee looked at a number of possible models for an organization that might cater for the interests of educational technology enthusiasts in Victoria. During informal discussions at the Toowoomba Media Education Conference in August, 1976, Deane Hutton expressed a belief that the South Australian based Society could be interested in investigating the concept of state chapters. The planning assumed a new direction, the tempo quickened and the Steering Committee met with Deane on several occasions when he visited Melbourne on other business. The way was finally cleared for the organizing of the public meeting in Melbourne, when on March 31st, 1977, the Annual Meeting of the Society in Adelaide passed the necessary constitutional amendments to provide for State chapters and a National Executive. The enthusiastic response to the invitations for the July 2nd public meeting was proof enough of the need for such an organization in Victoria and we are grateful to the South Australian group for their co-operation and assistance.

The National Executive, consisting of representatives of both chapters, has now had its first meeting and plans are in progress for the possible establishment of a New South Wales chapter. In addition, enquiries from other states also augur well for the future of the Society as a viable national professional organization.

At the time of writing, the Victorian Interim Council is finalizing

arrangements for a Special General Meeting on September 29th which should see the ratification of the Victorian Chapter Constitution and the election of the Foundation Council. The Interim Council has also been engaged in establishing the framework for the Chapter, to enable activities and publications to be provided for the varying backgrounds and interests of its members. The fact that this variety exists has been seen by the Council members as a source of strength for the Chapter, although it has also made the task of organizing a somewhat more complex one.

It is to be hoped that the next twelve months sees the Victorian Chapter develop into a forum for the exchange of views and the gathering of information by people involved and interested in educational technology.

Alex C. Millar
President

EDUCATIONAL TECHNOLOGY AT THE TERTIARY LEVEL *

David C.B. Teather

Academic Director, Audio Visual Learning Centre, University of Otago

Abstract

Concepts of educational technology have evolved, in part, from earlier notions about ways in which audiovisual media and other resources might best be deployed and used to improve teaching and learning. The response of many conventional tertiary educational institutions to 'educational technology' has been the creation of teaching support units, whose services are available on demand to teaching staff from other departments of the institution. This paper examines some potential strengths and some inherent weaknesses of such a 'cafeteria' approach, and briefly discussed the applicability to conventional institutions of an alternative model - the course team approach of the British Open University.

*Based on an address presented at a meeting of the New Zealand College of Education held at Dunedin Teachers' College, 9th September 1976. The meeting was one of a series held by the College on the theme "Educational Technology and Learning Resources".

John Brown, an assistant teacher of science, decided he would get with it. So he delved into the cupboards of his laboratory and brought out a slide projector, found a few slides and, after spending most of a double period talking at his third form about adaptation of animals to land, switched off the lights and in the few remaining minutes illustrated his lecture. The following week he borrowed the record player from the music teacher, and after that a film projector, so that by the time his Headmaster sent round a memo asking what aids he had used in his teaching during the term, he was able to tick every item on the list. But John Brown was far from being an educational technologist!

Mary Pearce, a social studies teacher, began the last week of her holiday with a resolve to get to grips with her fourth form course. She spent several days working out what skills her pupils should be learning, what methods she could best use to assess to what extent her pupils were learning what she had intended, what resources were available to assist her pupils to learn and what learning patterns her pupils would follow.

Teaching support services

John Brown's teaching set-up demands for certain types of assistance chiefly to make sure that the equipment he used worked. Mary Pearce could have been helped in the planning of her course had a source of good advice been available to her. Similar demands on the part of staff members of tertiary institutions in many Western countries, together with a number of other factors, have resulted in the establishment, in recent years, of teaching support units with a wide variety of capabilities.

Of the fifty such units in British Universities (Piper, 1973), the seventeen in Australia and the eight in New Zealand (Hore, 1977) no two are organised in exactly the same way or perform quite the same combination of functions. The same can be said of such units in

other tertiary institutions. They have all arisen individually, developing and responding to needs as perceived by each individual institution. The term 'educational technology' does not appear in any of the titles of the Australasian centres which Hore quotes, and the Director of the Advisory Centre for University Education in Adelaide is on record as saying that, within his university, he never uses the term. He states:

> Staff in tertiary institutions, but particularly those in universities, are often suspicious of educational technologists. The word 'education' brings memories of the esoteric nonsense which is all too prevalent in some educational journals, where the writer is seeking to impress his peers rather than to bring about necessary changes; 'technology' is interpreted as expensive gadgetry which breaks down. Bring the two terms together and the completely erroneous picture which is formed is hard to destroy. (Hall, 1975).

What then is the relevance of 'educational technology' in tertiary education? Dr. Hall came to his Adelaide post from the U.K., and it is appropriate to discuss the development of the concept of educational technology as it has arisen in the U.K. context.

From audiovisual aids to educational technology

In 1965 a committee chaired by Dr. Brynor Jones, Vice-Chancellor of the University of Hull, reported to the University Grants Committee on 'Audio-visual Aids in Higher Scientific Education'. The committee recommended the creation of a National Council for Educational Technology, which was duly set up. In its submissions to the Hudson Committee on Central Arrangements for Promoting Educational Technology in the United Kingdom (which reported in 1972), the Council differentiated between 'audiovisual aids' and 'educational technology' as follows:

> The 'Audio-Visual Aids' approach was based on the concept of 'enhancement' - of the provision of aids and assistance to the teacher, lecturer or trainer in his traditional role, which remained unquestioned and unexamined. Thus the benefits could only be in terms of increased effectiveness, but at increased cost, since both equipment ('hardware') and material (films, tapes, slides or teaching programmes, collectively described as 'software') have to be provided additionally.

Referring to educational technology, the Report of the Hudson Committee stated:

> Its present prominence stems largely from the emergence of new technical aids and of new knowledge about learning and about the processes of communication, and it embraces not simply the use of the new equipment and techniques but also their adoption and co-ordination to serve new patterns and systems of learning. This involves a shift from a predominantly intuitive attitude to teaching and learning towards a more systematic and analytical approach. The practical consequences of this change in attitude include a closer attention to the definition of objectives, selection and systematic use of the most appropriate and effective techniques and devices, and attention to evaluation of results for the purpose of assessing or modifying the learning programme.

The National Council's provisional definition of educational technology, which it reaffirmed in 1973, is: *"the development, application and evaluation of systems, techniques and aids to improve the process of human learning"*. This broader view now has international acceptance, as one can see in reports from Europe (Centre for Educational Research and Innovation, 1971), North America (Carnegie Commission on Higher Education, 1972) and more recently from Australia (Open Tertiary Education in Australia, 1975).

What we are concerned with, in educational technology, is nothing less than the process of making *informed* and *rational* decisions on the allocation and use of educational resources. Making such decisions usually implies a fairly systematic approach to the particular problem being studied, and the Australian report lists ten activities of special concern in a systematic approach to education:

(a) establishing general goals
(b) ascertaining student characteristics
(c) setting objectives
(d) arranging learning sequences
(e) designing appropriate learning materials and experiences
(f) testing and developing this design
(g) producing the required materials
(h) distributing materials
(i) operating a feedback and evaluation system
(j) modifying objectives, materials and processes in the light of the operation of the system. (Open Tertiary Education in Australia, 1975.)

This is the scope of educational technology. This approach, or modifications of it, can be applied in a wide variety of contexts, from an individual lesson, to a course of study, to a complete degree programme.

One might well ask what is novel about such an approach. And indeed, the Australian report makes the point that "there is nothing new in such an instructional design plan other than its formal statement and systematic implementation. Good teachers at all levels have used variations of such a system, often intuitively." Why then the prominence given to educational technology today?

Educational Technology: a timely concept

One can attempt to account for the current interest in educational technology by relating two contemporary trends. Firstly, developments in educational theory which stress the importance of 'individualising'

or 'personalising' instruction. L.C. Taylor, keynote speaker at the Commonwealth Conference on Materials for Learning and Teaching held in Wellington in 1975, said: "The shift has been towards heuristic, active, individual and small group learning, away from received authority, passivity and class teaching" (Taylor, 1976). It is a shift which is taking place at all levels in the educational system. A very useful overview of developments at the tertiary level is provided by Goldschmid (1976).

So educators perceive a need for more "heuristic, active, individual and small group learning" and at the same time we have the development of learning resources which hold out the promise of enabling us to meet this need. One can encourage students to access directly information which has been recorded in a wide variety of media - audiotapes, colour slides, videotapes and films, to name the most obvious complements to print. Replay equipment is becoming more reliable, more portable and easier to operate. With the development of sufficient software of high quality, one should be able, to a large extent, to say goodbye to the traditional model of a teacher talking to 30 students at a time, and to courses in tertiary institutions which depend so heavily on frequent, regular lectures of the type which merely serve to convey information from the lecturer's notes into the notebooks of the students - as the old adage says, without necessarily going through the minds of either!

One conventional university's response

So far we have dealt in generalities. Let us now consider one tertiary institution's response to these concepts. When Professor Paul Hirst addressed the New Zealand College of Education on the inter-relationship of universities and teachers colleges in U.K., he commented on the approach of universities towards the construction of new degree courses, in this case the B.Ed.:

> ... within any university, certainly one of long standing, there is a tradition as to what counts as a degree and there is established within the institution some general framework into which any new degree must somehow fit. The exercise of planning is somehow to work within an existing framework, to squeeze it where you can get away with that, and to build the best thing you can by way of a new degree within the existing framework. (Hirst, 1976.)

What Paul Hirst was saying can be generalised. The administration of our universities, like the administration of justice, depends largely on precedent. This is not to say that universities are static - clearly they do change and adapt to new circumstances. But they typically adapt in ways which cause least internal friction. Thus when pressures grew in the University of Otago for the development of new methods in teaching and learning, the response was - as has been the case in many other conventional universities - not systematically to examine the teaching of departments or of faculties, but to create teaching support services available to those staff who wished to avail themselves of the services offered.

The Audio Visual Learning Centre of the University of Otago is one such service. Its foundation and early development have been described in more detail elsewhere (Teather, 1975). Established in 1973 it has three main areas of responsibility:

(1) to assist staff in the identification and solution of teaching problems;
(2) to establish facilities by which students can gain direct access to audiovisual learning materials (this has, in fact, meant doing a job which is in many universities undertaken by the library);
(3) to establish a production unit for audiovisual learning materials.

In the first four years of its development the Centre has had some modest successes. Although its advent was (so I am told) regarded with

suspicion by some staff members who had visions of classes being handed over to various mechanical gadgets and of a sharp decline in interaction between teacher and student, the reality has proved to be very different. Indeed many of the applications of audiovisual media with which the Centre has been concerned have been designed to enhance, if not the amount, certainly the quality of teacher-student and student-student interaction.

It is worthwhile briefly considering some examples. Short video-recordings of simulated doctor-patient interviews have been produced to trigger discussion between general practitioners about the ways in which they normally handle counselling problems posed by patients. The recording of techniques in laboratory courses, on film loop, video-cassette, tape/slide or printed formats, has obviated the need for repeated, live demonstrations by the teacher, thus allowing him to spend more time on those problems which can only be tackled effectively by one-to-one or small group tutoring. The videorecording of students' performances - students of theology giving sermons, students of education conducting a class, music students performing an opera, students of physical education engaged in gymnastics - and the subsequent playback to the individual concerned together with, as appropriate, his tutor and peer group, is another application of media which has the effect of enhancing teacher-student and student-student interaction. Interaction, concerned with problems of teaching, between teaching staff themselves can be a useful form of spin-off from projects involving the use of media; a recent example is the production of a series of linked tape/slide presentations in which five staff members from the Department of English co-operated closely.

I have explored elsewhere (Teather, 1977a) the notion that teaching staff from departments who work with staff of educational technology centres in the planning and production of teaching materials for part of a course gain skills and insights which materially improve the remainder of their teaching. Indeed I see this as a major justification of the provision of educational technology centres in tertiary

institutions of the conventional kind. Staff of such centres can fulfil, usually quite informally, a teacher education function which may have considerable value for teaching in the institution as a whole.

An alternative model

There are, however, limitations as to what can be achieved by a Centre whose participation in the ongoing teaching and learning process of the institution of which it is a part depends on requests made by individual staff members of other departments. Clearly, resources might well be spent improving courses or parts of courses, which are already effective, while areas seriously in need of upgrading might receive no attention. Within the context of traditional universities, in which the autonomy both of the department and of the individual staff member is strongly held, this problem has no clear solution. (Some would judge it to be but a small price to pay for maintaining the present degree of departmental and individual autonomy.) In other tertiary institutions the situation might well be different, and it is worth noting that some newer universities are themselves adopting a rather different approach.

The most notable of these is perhaps the British Open University. (Rowntree, 1976, has recently edited a stimulating collection of papers on aspects of the work of the Open University's Institute of Educational Technology.) In the Open University the structure of course teams makes specific provision for the involvement of educational technologists in course production and, moreover, the University's system of distance teaching makes imperative the use of media for communication between academics and their students. There are no such factors compelling staff to welcome the involvement of educational technologists in on-campus teaching in the conventional institution. Here involvement of educational technologists on the scale found at the Open University would seem to be quite out of the question, even if this were considered desirable.

The example of the Open University is particularly interesting as it is in distance teaching contexts that the kind of systematic analysis typical of an educational technology approach can yield benefits which are immediately obvious. The economies of scale made possible by enrolments of several thousand students in each first-year class allow the production of self-instructional materials of very high quality, even though these are costly to produce in terms of man-hours.[2] It can be argued that such meticulous design of courses and of learning resources is not required in conventional institutions, for one can make up, by personal contact, for inadequacies and ambiguities in information presentation. However, the realities of teaching in conventional institutions, particularly at first-year level where classes may be numbered in hundreds and tutorial groups may be as large as many a school's 7th form, make teacher-student dialogue difficult to achieve by conventional means. In such a context the use of media to stimulate and to encourage peer teaching can be highly relevant.

Conventional tertiary educational institutions present educational technologists with unique challenges, for such institutions harbour both constraints and opportunities which are distinctly different from those which are faced by their colleagues in the Open University. While there are aspects of the University's experience in designing and teaching courses which must be taken into account if self-instruction is ever to form a regular and important part of study in a conventional university (Bates and Pugh, 1975), alternative strategies likely to lead to a significant involvement of educational technologists in the ongoing pattern of teaching and learning in traditional institutions are also available (Teather, 1977b). It is likely, however, that in conventional institutions the tertiary sector's equivalents of John Brown and Mary Pearce will continue to plough their individualistic furrows for some time to come.

Notes

1. The number of full-time staff of the Open University Institute of Educational Technology, as at March 1975, was 69 (Northcott, 1976).
2. Bates and Pugh (1975) remark: "The average yearly production norm of a science academic at the Open University is 1.6 units (i.e. 1½ week's work for a student) ... equivalent to 1½ text-books of 22,000 words, plus the design of home-experiments and the development of the necessary equipment, assignments, television and radio programmes, etc., plus, of course, time for research."

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SIMULATION IN MEDICAL EDUCATION

David I. Newble
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Abstract

Simulation techniques in medical education can help overcome problems in the teaching and evaluation of those skills required to become a competent doctor. The variety of simulation techniques in current use can contribute to motivation and can reduce the risk to patients exposed to students. The needs of evaluators will be an important stimulus to the further development of simulation.

Introduction

Medical educators are concerned with the teaching and evaluation of the complex skills required to become a clinically competent doctor. The practical aspects of these activities have traditionally taken place at the patient's bedside. Clearly, this has disadvantages for student and patient if the skills to be learnt have elements of discomfort or risk. Some emergency skills cannot be taught all in this way. The development of sophisticated simulation activities and devices in the fields of warfare, space exploration and the airline industry has led to a growing interest in the use of such techniques and technology in the training of doctors.

Christine McGuire (1974), a leading medical educator, states that:

> ... reduced to its essence, simulation consists merely in placing an individual in a setting that imitates some aspect of reality, and designing around that setting a problem which requires the

learner's active participation in initiating and carrying through a sequence of inquiries, decisions and actions.

Two of the most important aspects of simulation are active participation and the fact that the setting can be standardised, a great advantage when evaluation of students is concerned. With more sophisticated simulations the approach to the problem can be modified by the learner. The limiting factors include the feasibility in terms of both cost and technology and acceptance by students and, more particularly, teachers. The latter viewpoint has been expressed by Pappworth (1974):

> God forbid that British teachers and examiners should ape the Americans by employing professional actors to play the part of patients and simulate special disease, or showing still or cine-films instead of actual patients. May we be saved from a new generation of students prodding plastic swellings in dummies and analysing artificial urine. Our profession must be protected from the technomaniacs who consider clinical medicine to be a game which can be placed with artificial materials instead of actual patients, and that by manipulating a computer, even a sick one, clinical ability can either be learned or assessed.

This must be regarded as an example of extreme British conservatism, anti-American feeling, gross ignorance or a total misunderstanding of the aims of those responsible for developing techniques of simulation. While some may be over-enthusiastic about particular simulation methods, and although not all will be found to be practically useful, the concept of simulation has been proven to be sound. How many of us would now be prepared to let the airline pilot await the emergency situation on the job when his abilities to react to these situations can be tested in a simulator? The truth is closer to the opinion of Jason and Tichtov (1971) when they express the view that simulation is likely to become the most important new educational approach of the decade.

Techniques of simulation in current use

1. Paper simulations
2. Computer simulations
3. Simulated patients
4. Simulation devices
5. Games

1. Paper simulations

These are now widely used in America as a test of clinical competence. They have not been used extensively in Australia. The Patient Management Problem (PMP) has been developed by McGuire and her colleagues (1971) but many adaptations have been reported.

The typical PMP begins with a variable amount of patient data. The student is then requested to collect additional data in a sequential fashion in either a linear or branching fashion depending on the sophistication of the simulation (Figure 1). The answers are obscured in various ways and the student only gets the answers to items he selects. The pathway of the student through the problem is compared to that of an expert or criterion group.

The virtues of the PMP lie in the content validity and the moderate fidelity of the simulation. It is believed to measure some aspects of problem solving skill and evaluates skills not tested by objective items (McGuire and Babbott, 1967). It is fairly easy to develop, is relatively inexpensive and can be administered to large numbers of students.

The PMP also has limitations. The reliability is unknown and the scoring methods have been extensively criticised. The cueing effect of the lists of available options is also a disadvantage and comparable to that of cueing in objective tests. Despite these limitations the method has been well accepted by students, particularly when used as a teaching tool.

Figure 1 Patient Management Problem

A 45 years old patient presents to the Casualty Department with a complaint of chest pain.

Section 1

YOU WOULD NOW ELECT TO (CHOOSE ONLY ONE)

1. Perform physical examination	1	
2. Take further history	2	TURN TO SECTION 5
3. Admit the patient	3	
4. Order laboratory tests	4	
5. Refer back to general practitioner	5	

Section 5

IN TAKING FURTHER HISTORY YOU WOULD BE PARTICULARLY INTERESTED TO INQUIRE ABOUT (SELECT AS MANY AS YOU CONSIDER PERTINENT):

1. Nature of the pain	1	Crushing feeling
2. What makes the pain better	2	Rest
3. What makes the pain worse	3	Exertion
4. Location of the pain	4	Retrosternal
5. etc.	5	etc.
6. etc.	6	etc.

(after McGuire and Solomon, 1971)

2. Computer simulations

The development of computer simulations has stemmed from work in computer assisted instruction (CAI) and is particularly evident in North America (Hoffer, et al, 1975). The technical problems will not be discussed in detail but the increasing sophistication of terminal hardware is making computer simulation more attractive. These advantages, however, have to be weighed in terms of cost effectiveness.

The most widely used simulations are a direct extension of the paper PMP. The most sophisticated of those is CASE - A Computer Aided Simulation of the clinical Encounter (Harless, et al, 1971). This is basically a branching PMP but incorporates limited natural language capabilities. In other words, the student himself types in the question rather than selecting the question from a predetermined list. This avoids some of the cueing problems of the paper version.

The most recent developments surround the new educational computer system, known as PLATO (Alpert and Bitzer, 1970). It has the capacity to display a wide variety of audio-visual materials at the student terminal. However, cost is such that time-sharing networks are essential and it is unlikely to be seen in widespread use in Australia in the near future.

Computer simulations are in use in Canada as part of the assessment procedures of the Royal Colleges of Medicine and Surgery. A computer based examination is envisaged by the National Board of Medical Examiners for re-certification in America (Senior 1976). Despite the acceptance by these bodies there are still doubts about the scoring of performance.

3. Simulated patients

Simulated patients have been predominantly used for teaching and evaluating skills in clinical interviewing and physical examination. The contribution of Barrows in this field should be acknowledged (Barrows and Abrahamson 1964, Barrows 1971). He defines the simulated

patient as "a person who has been trained to completely simulate a patient or any aspect of a patient's illness depending upon educational need".

It is claimed, with justification, that simulated patients can often provide more effective instructional and learning experiences than real patients. They are more readily available and can, therefore, be scheduled. They also allow certain risk problems to be overcome and can broaden the teaching situations where situations would not normally be available or would be ethically and medically unacceptable. The fidelity of the simulation can be very high. Barrows, for example, has constantly 'fooled' internationally famous neurologists with his trained simulators of neurological disorders.

In the field of clinical evaluation simulated patients appear to have a major role. The use of real patients in certification examination has reduced the reliability of student assessments to little better than chance. The provision of stable patient problems to all students may overcome this difficulty. Preliminary work has supported this contention (Lamont and Hennen, 1972, Levine and McGuire, 1970). The use of simulated patients is being actively explored in Australia and the author has recently used simulated patients in an examination of clinical competence for medical students.

4. Simulation devices

There are currently available a multitude of devices which allow a student to interact with models, machines and audiovisual materials. The majority of these devices are directed towards skill training, particularly physical examination skills. Major research and development programmes are underway in several medical education centres and some have clinical simulation laboratories (e.g. Sajid, et al, 1975).

These devices range from simple models of eyes which allow ophthalmoscopy skills to be developed (Figure 2), models to allow skills in mouth-to-mouth respiration and cardiac massage to be practised (Figure 3)

Figure 2 *This model allows ophthalmoscopy skills to be developed*

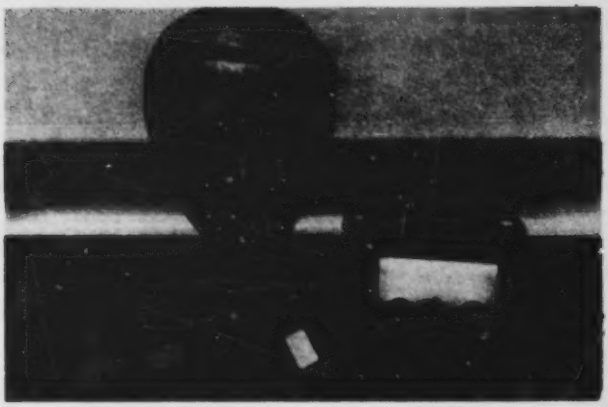

Figure 3 *Mouth-to-mouth respiration and cardiac massage can be practised on this model*

Figure 4 *Skills in anaesthesia and resuscitation can be taught using this computer controlled manikin*

through to highly sophisticated computer controlled manikins to teach and test skills in resuscitation and anaesthesia (Denson and Abrahamson, 1969) (Figure 4). Such devices have the advantage of allowing potentially dangerous skills to be taught, therefore reducing patient risk. Even with less dangerous skills, the establishment of a minimum level of dexterity prior to patient contact would save many patients considerable discomfort.

Early reports on the effectiveness of simulator devices are encouraging (Penta and Koffman, 1973). Many of these devices are now commercially available.

5. Patient games

Games have been extensively used in schools, the business world and by the armed forces. They may be simple or extremely complex. Games differ from other simulation devices as they imply a personal involvement, in an abstract situation, often with a group and in a competitive environment.

Little work has been done in this field in medical education. Maatch (1974) has developed a series of patient games which can be played by individuals or groups. They aim to teach and evaluate the fundamentals of diagnosis and management. An instructor is provided with a kit containing information about the patient and acts in some ways rather like a simulated patient. A flow diagram charts the students' decisions and progress. A more sophisticated computer backed game has been developed which allows participants to conduct a clinical trial on a new drug over a three day workshop (Maxwell, et al, 1972). The game is currently being offered in Western Australia.

Summary

There seems little doubt that appropriately designed simulations can induce a high degree of motivation which is a prime prerequisite for learning. Simulations may be particularly important when it is difficult to provide 'real' situations, or when it is hoped to reduce discomfort to patients exposed to the untrained student. The major stimulus to the further development of simulation is likely to come from the needs of evaluators, particularly in the areas of assessing the competence of students and practising doctors. It is here that current testing techniques are quite inadequate. The extent of such development will be limited, particularly in this country, by the initial costs involved.

Footnote: This article is based on part of a major review of the problem of evaluating clinical competence (Newble, 1977).

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TEN YEARS IN EDUCATIONAL TELEVISION

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Maybe a shipwrecked sailor adrift on the ocean is not the best person to compile an objective weather report. Certainly, an army private dodging the shells of battle, hiding in the trenches and scrounging ammunition is almost incapable of being an objective war correspondent. In a vaguely analogous manner, the writer of this article on educational television finds that objectivity in this subject is an elusive quality. In the past ten years, I have been associated with the production of more than 430 educational television broadcast programs - in various roles, including those of scriptwriter, presenter, educational adviser, producer and director. These programs have been produced for the Channel Nine network, the Australian Broadcasting Commission, the Schools Commission, the Curriculum Development Centre, the S.A. Education Department and the Australian Academy of Sciences.

Consequently, any account of the past decade of educational television will be unashamedly subjective. Although some attempt will be made to relate the topic to recent literature in the field, the account will be punctuated with highly specific observations and introspective meanderings.

What can television do?

Anyone who has been forced to stand in the pool of hot light in a TV studio and stare into the empty blackness of a silent, cavernous zoom lens will certify that television can be an awesome monster. As the final ten seconds are counted down before going 'on air', doubts and questions race through the mind. 'What am I doing with this medium?'

'What is this medium doing to me?' 'Who is watching out there?' 'Is anyone out there?' 'What am I doing here, anyway?'

Quite apart from the devastating psychological effects that television can have on presenters and the soporific effects that it might have on viewers, the medium does have certain fundamental physical capacities. There are certain things that television can and cannot do as a communication medium. Maclean (1968) claims that television has just four fundamental capacities. These are:

(1) the capacity to *manipulate size* - to magnify or diminish visual images;
(2) the capacity to *store* visual and auditory information (on videotape);
(3) the capacity to *assemble* heterogeneous material (e.g. studio action, film, photographs, graphics, narration, music, sound effects) into a coherent whole;
(4) the capacity to *distribute* visual and auditory information from one point to another immediately.

Television shares the first three capacities with film, but the fourth is unique to television. And, of course, this ability of television to distribute information immediately, enables a director to use three or more studio cameras to bring together different viewpoints of the same object or event, and couple these with film, photographs and graphics. Thus, television's distribution capacity strengthens its assembly capacity.

New advances in electronics will undoubtedly bring new television facilities in the years to come, but the same fundamental capacities of the medium will remain. I have found that Maclean's identification and description of these features provide a very useful set of guidelines in scripting and designing educational television programs and program segments. I have continually referred to the 'four fundamental capacities' when exploring alternatives in organizing and presenting

the *content* of a program. 'Is television's capacity to show a larger-than-life view being exploited?' 'Can we use comparison of pre-recorded and live material to emphasize similarities and differences?' 'Is material being drawn from a wide range of sources?'

The 'fundamental capacities' of Maclean are aspects of television *technology*. Salomon (1976) claims that two aspects in addition to technology need to be considered when designing television programs. These are: the *content* of the message transmitted; and the *symbolic code* in which the message is transmitted. Salomon asserts that, "The fact that particular contents excite or provoke has nothing to do with the medium" (Salomon, 1976). There may be some truth in this, but I think it overlooks those important moments when content coincides with television technology. Take almost any miniature and unusual object or event and enlarge it to the size of a television screen and it is almost certain to excite.

So far as symbolic code is concerned, "Television is a prime example of a medium whose code is based on other codes" (Salomon, 1976). Like films, filmstrips, slide sets and books, television can use words, signals and pictures to convey meaning - and, like these other media, the design of television includes selecting from these alternate symbol forms. Hutton and Lescohier (1976) describe procedures for selecting from words, signals and three types of picture (iconic, analogical and logical) when designing visual messages. The use of analogical pictures or visual analogies in instruction is described in detail by Knowlton (1966), but has been used with relative infrequency in educational television. Books such as those in the Time-Life Nature and Science series have made frequent use of visual analogies - pictures of one thing to explain another object or event - but educational television producers seem to prefer iconic pictures (realistic film, photographs, drawings) and logical pictures (abstract diagrams, charts, graphs). The whole realm of analogical pictures would seem to be one with enormous potential, not only for educational television, but for television in general.

Television for the masses

We can talk and argue for hours about the merits and potential of television as a means of communication, but we cannot escape the fact that we are dealing with a monster which has an enormous appetite. The ability of television to consume productions so rapidly almost guarantees that program standards will either start high and drop, or else maintain a low level of aspiration. Walker (1976), describing the situation in Melbourne, captures the essence of the problem for any country with a small population. He says:

> Man's first walk on the moon must have been TV's most memorable achievement.
>
> Sport when it is simultaneous, news when it is actual, election counts, the occasional high-spot in drama, the vibrant personality interviewed, the gifted variety performer, the rare original comic have added to its fascination.
>
> But in the main it seems to be stuck in the mud of mediocrity. The chances are there is too much of it to maintain any continuing higher standard.
>
> In an average week in Melbourne the camera's hungry eye is roving over the restless planet in search of substance for no less than 430 hours of telecasting. That represents about 550 different programmes. Small wonder so much of it is tasteless stuff.

In addition to insatiable appetite, mass television has two other spectres which can also haunt the designers of educational television. These are television's insistence on ruthless editing to maintain pace, and the unwarranted credibility that the masses frequently heap upon anything emanating from the little box in the corner of the room.

Perhaps the ruthless editing can best be illustrated by examining a

television news service. A typical half-hour news broadcast would contain less than 2,000 words - to cover all the international, national and local stories. This represents less information than is normally printed on a single page from a newspaper. Inevitably, TV news coverage tends to be superficial. In describing television journalism, Adams (1976) says:

> If Moses handed down the Ten Commandments, the lead would be 'Moses today came down from the mountain with Ten Commandments, the two most important of which were ...

The scriptwriter of an educational program is faced with the same problem. 'How can I teach Einstein's theory of relativity; or an appreciation of Mozart's music; or the concept of 'sharing' - in 15 minutes?' 'Is it worth trying?' 'Will it lead to a misunderstanding or restricted view of the topic?' Only when the televised material is seen as a stimulus for the viewer to seek further information on these topics does it seem worthwhile scripting such programs. And yet, newspaper surveys suggest that a large and increasing proportion of the population relies on television as its only source of news (Adams, 1976).

Educational television does not seem to have the same power over viewers as TV news, and yet they are both frequently accorded a level of credibility above that which they deserve. Members of the general public will question the truth of the printed word in newspapers, magazines and books, but tend to believe what they see on the TV screen. The young child smiles with pride when he can back up claimed knowledge with a reference to the ultimate in primary evidence: 'I saw it on the telly!'.

I remember being mystified by the reactions of many of my science students a few years ago when I was teaching at a high school and also presenting a weekly ten-minute science segment on a local 'live' television program. Several times I carried out, on television, a science experiment or demonstration which had been performed previously

in the laboratory with my science class. The television version would stimulate more interest, discussion and questions than its laboratory counterpart. Same teacher, same experiment, same students - but a different reaction. Why? At first, it would seem to be another simple example of the unwarranted credibility of television, but other factors may have been operating as well. For example, television may have presented some children with the ideal vantage point from which to observe the experiment, whereas the laboratory view may have been far from satisfactory. Also, the television presentation may have given some children, from the science class, a sense of being involved in the sharing of information with thousands of other children.

Education and television: impossible marriage?

Many developments in educational thinking in recent years have given increasing status to the needs and problems of the individual learner. By its very nature, broadcast television must be concerned with a large number of individuals and, consequently, a vast range of ages, interests and abilities. This often leads to productions which are aimed at the lowest common denominator among potential viewers. Many will remain unchallenged or even bored.

Can the fundamental aims of education and television be reconciled? Some reconciliation must be possible if we consider the amount of learning that can and does occur, in people of all ages and abilities, from documentaries, current affairs programs, and TV commercials. The problem is to instil formal instructional television with some of the same qualities that are possessed by many of the program sources from which so much incidental learning occurs. Schlater (1970), after investigating the effect of speed of presentation on the recall of televised information, concludes:

> If instructional in-school television is to make its impact, its producers must be willing to utilize some of the formats and production techniques of commercial broadcasters in order to compete for the attention of the student audience.

The 'Sesame Street' project of the Childrens Television Workshop in New York is the most obvious example of a thorough penetration of entertainment and advertising techniques into educational program design. The development and evaluation of Sesame Street has been described in detail by Lesser (1974). Meilke (1972) claims that the most noteworthy contribution of 'Sesame Street' to educational television in general was:

> The successful marriage of the social sciences with the creative arts at the conceptualization stage, and research with production at the implementation stage.

I remember well the repercussions that Sesame Street had on the planning and production team of the 1971 school-age edition of Here's Humphrey (which was the forerunner of the Curiosity Show). I was a member of that team, and vividly recall the stunned silence that followed our viewing of a sample Sesame Street program before the series went to air in Australia. Our program was aimed at a completely different age level, but we felt that Sesame Street offered important suggestions in production technique and format. We could not afford the extensive animation in our program. We knew of no available puppets of the calibre of Jim Henson's Muppets, which were featured on Sesame Street. We could and would match it in pacing and variety. We would increase the amount of outside filming to be incorporated into our program. And, ever since that day, we have been chasing that elusive brand of humour that is so characteristic of Sesame Street, and yet which has escaped comprehensive description in most of the analyses of the series - even those conducted by the Childrens Television Workshop itself. I am convinced that a thorough understanding of the role of humour in instruction is a key issue in developing guidelines for improved educational television production for all age levels.

Sesame Street provided a much needed stimulus to educational television in Australia in the early 1970's. Even those who opposed its basic

philosophy were forced to rethink their own, and to discuss aims and objectives in overt terms. Also, the example set by the Childrens Television Workshop in building systematic evaluation into the process of educational television design and production remains an ideal which others strive to reach. In most of the programs with which I have been associated, little, if any, funds have been available for systematic research. The one notable exception is "See-Saw" - a pilot educational television program which has been jointly funded by the Salisbury College of Advanced Education research committee and the television station NWS 9, Adelaide. Surveys,trials, screening with sample audiences, and formative evaluation have formed an integral part of this developmental project. The findings from this project are still being analysed and the future of See-Saw will depend on these and on raising sufficient financial support from TV stations around Australia to transform the pilot into a limited series of half-hour, educational television 'specials'.

Educational television presenters

The morbid fear generated in the human organism by a combination of studio lights, television cameras and a backwards-counting floor manager is well known. It is evident in the faces of almost all novice television presenters - and a significant number of experienced ones as well.

Page (1976) has examined 'the TV studio effect' in detail and offers a collection of anxieties expressed by people who have faced the cameras and analysed their own responses. Included among these are the following comments:

> In the earlier sessions there was a certain nervousness which created a tension in individuals ...
>
> It soon became evident that, even when camera shyness dissipated, there was a residual unwillingness to be too committed ...

> I could never forget that I was being recorded on tape for posterity. I found this inhibiting ...
>
> The TV camera ... compels one to say something whether it is relevant or not; a self-consciousness that what one is saying has to be accurate from the grammatical and logical angles; a feeling of artificiality, of a forced situation.

Given the difficulties and anxieties associated with television presentation, why do people volunteer for the job and what characteristics do they need for success? Gilliom (1971) claims that a potential television teacher needs three basic ingredients before considering the details of the job. The ingredients are: 'a bit of gall, a thick skin, and an extra portion of poise'. The gall is needed to say to yourself, 'I am a good enough teacher to teach thousands of students instead of the conventional thirty to a class'. The television teacher or presenter does not have the security of a classroom teacher. He has no captive audience. He can be switched off, ignored or scorned by students, teachers, enemies, relatives or friends. And this is where the thick skin is needed. As a television teacher, you are opening your classroom door to educators, students, parents, and the general public. You lay your professional reputation on the line every week. You must expect criticism, because by your very actions you are inviting criticism and you will get it. When things go wrong - and they do - the television presenter must reach for that 'extra portion of poise', that calm self-confidence, that unflappable nature, that 'cool' which we expect of anyone in the public eye. Technical blunders, such as moving too rapidly for the camera, can be overlooked. Factual errors in content can be forgiven. But losing 'cool' in a crisis is fatal to a television presenter.

Every time I make a major blunder while compiling a pre-recorded television program, I say a silent prayer of thanks for the invention of the videorecorder - which enables us to erase our mistakes. Every time I am required to present material on a 'live' television program,

I find it very difficult to eat anything prior to the program, because the struggle to build up reserves of 'gall, thick skin and poise' plays havoc with my digestive system. My discussions with others in the field suggest that this is not uncommon - even after ten years!

Gilliom (1971) claims that supplementary requirements for the educational television presenter are:

(1) successful experience in classroom teaching;
(2) willingness to learn new technical and communication skills;
(3) creativity, imagination, inventiveness;
(4) knowledgeable, contagious enthusiasm about the subject matter;
(5) the ability to work with a large team of people;
(6) a good oral command of the English language;
(7) a general resonance of personality.

I first encountered Gilliom's list after being associated with educational television for seven years. My immediate conclusion was that I should never have appeared as a presenter! However, I have since added an 8th characteristic for the TV presenter which, I think, can compensate for deficiencies in many other areas. This 8th characteristic is stubbornness, pig-headedness, obstinacy, the refusal to admit that something cannot be done. There is, though, one characteristic in Gilliom's list for which there is no substitute. It is 'knowledgeable, contagious enthusiasm about the subject matter'. This essential ingredient can be seen in abundance in the following:

Harry Butler's love of animals ('In the Wild')
Peter Wherret's enthusiasm for cars ('Torque')
Julius Sumner Miller's knowledge of physics ('Why is it so?')
Garry McDonald's sense of the ridiculous ('Norman Gunston Show')

Contagious enthusiasm is not something that comes easily to those of us who are, by nature, shy introverts. I remember well the evening in 1967 when I had my first audition for an educational television

program. Being a shy introvert, but having an intuitive belief that contagious enthusiasm was essential in this medium, I had spent weeks soaking up every book I could find on the rather dull science topic that had been given to each of the five teachers on trial. When the floor manager reached 'zero' on his count-down, I switched on my 'contagious enthusiasm' with eyes gleaming, tongue flapping, arms waving, pictures flashing and models working. I surprised myself more than the producers and other teachers. Ever since that night, I have led a dual existence - a Dr. Jeckyll and Mr. Hyde. Most of the time, I am a quiet, mild-mannered, shy introvert; but the moment the cue light flashes on a television camera, the other being - the raging extrovert - takes over. To forestall attempts to have me certified, I think I should point out that this radical oscillation is not uncommon among shy people who become teachers. It is just a little more exaggerated and a lot more public in the case of an educational television presenter.

Growing concern for educational television

The year 1977 has seen an enormous upsurge in interest in and concern for educational television. This growing concern has resulted from several concurrent developments.

A survey of the TV viewing habits of children in the Sydney area by Tindall, Reid and Goodwin (1977) confirmed previous findings and suggested that three hours of television viewing per day is the norm for children from kindergarten to Year 12, and that totals of five to six hours per day are not uncommon. Studies from other Western countries have produced similar figures.

Television, then, is firmly established alongside the home, school, church and peer group as an important social influence on the individual. Bandura (1969) has suggested that children and adults can modify their behaviour patterns as a result of observing behaviour models in the immediate environment. A number of psychologists and sociologists (e.g. Greagg, 1977; Noble, 1973) have investigated the

effect of television violence on aggressive behaviour in children and found some positive correlations between the two. Other researchers (e.g. Murray, 1976; Stein and Friedrich, 1972) have also examined the ability of television to convey prosocial messages and claimed success for the medium in this respect. Findings such as those mentioned above have been used by many individuals and groups to support claims that stricter legislation should be passed to control the portrayal of violence on the TV screen. On the other hand, some studies (e.g. Feshbach and Singer, 1971) have suggested that the viewing of televised violence by some children under some circumstances might have a cathartic effect and reduce the likelihood of aggressive behaviour. So we are faced with discrepant findings, together with the eagerness of some people to make television the scapegoat for a multitude of social ills, and the equal vigour with which others deny the influence of television on human behaviour. Quite clearly, there is an urgent need for more research on relationships between television viewing, types of message and social behaviour.

Research needs in educational television

Into the ferment described above have come two public inquiries into television in 1977. The first was the Australian Broadcasting Tribunal's Public Inquiry into the Concept of Self-Regulation by Australian Broadcasters. This was followed by the Senate Inquiry into the Impact of Television on the Development and Learning Behaviour of Children. Hundreds of concerned individuals and groups have given written and oral submissions to these two inquiries, and this, in turn, has generated much public discussion and debate on issues raised in the public hearings. I certainly hope that some focus can come from these two inquiries that will be of positive value to all those involved in the design, production and evaluation of educational television. I would like to see this focus include the establishment of a research institute, clearinghouse or advisory committee, for the purpose of undertaking research studies, providing advice and disseminating findings to designers and producers of educational television (Hutton, 1977).

Not only is it important that more research studies be undertaken, but also that they be embedded in a conceptual framework that will enable them to be interpreted and used by many others. Salomon (1976) has provided a useful framework for studying television variables; Coldevin (1977) has suggested a matrix for examining television presenter stereotypes; Bates (1976) has outlined categories of research and evaluation in the whole field of educational broadcasting; and Heidt (1977) has given some clear guidelines for relating research in a particular medium, like television, to general media research.

Let us hope that an increasing number of focussed research options in educational television will be taken up around Australia in the near future - and that new thrusts in program development will occur simultaneously.

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RATE-CONTROLLED SPEECH: A REVIEW

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Abstract

Rate-controlled speech is speech which is presented at a rate faster than normal (compressed speech) or slower than normal (expanded speech). Speech may be compressed by a sampling method in which short segments of the speech signal are deleted and the remaining segments are abutted in time. The discarded segments are brief enough so that at least a portion of each speech sound is reproduced. Expanded speech may be produced by repeating brief segments of the speech signal. The pitch of the recorded voice is unchanged by the compression or expansion process. Machines available for compression/expansion are described briefly.

Comprehension of compressed speech has been shown to be virtually unchanged by compressions up to word rates of 275 words per minute (almost double the normal speaking rate). The ability of adults to comprehend compressed speech is correlated with intelligence and reading rate and for children to be correlated with age-grade level.

It is claimed that speech compressors provide the freedom to listen at the optimum word rate, to scan quickly or to listen more slowly as the content demands. Students in required college courses taught by self-paced audiovisual methods using speech compressors have saved significant amounts of times and have expressed favourable attitudes towards compressed speech. Compressed speech has also been used as a pacer to increase reading rates. Expanded speech has been used in foreign language learning and with mentally retarded children.

Definitions

The term rate-controlled speech refers to speech which is presented to a listener at a rate which is controlled (faster or slower than normal) irrespective of the means by which this control is achieved. Speech presented to a listener at a rate slower than normal is designated expanded speech. Speech presented at a rate faster than normal has been variously designated as speeded, accelerated, compressed or time-compressed speech. Although there have been some attempts in the literature to associate certain of these latter terms with certain means of rate control, in this paper the terms will be considered to be synonymous. The terms expanded and compressed speech will be used to refer to the two possible cases of rate-controlled speech. Since most of the research studies and practical applications of rate-controlled speech have occurred in compressed speech, only brief consideration will be given in this paper to expanded speech.

Production of Rate-Controlled Speech

There are three methods by which compressed speech may be produced.

Speaking rapidly

Speaking rapidly is the only method for the production of compressed speech which does not require the use of recordings. This method is included here for completeness, and to bring to notice certain properties of speech which are important for later consideration of the other methods of production of compressed speech.

The rate of normal speech has been measured by various experimenters. The normal oral reading rate, as produced in the reading of a prepared script, may be considered to be in the range 125 to 175 words per minute (Foulke, 1968). The normal rate of production of spontaneous speech varies from person to person and also from time to time with a given person depending on the circumstances and the state of mind of the speaker. The word rate is slower, for example, in the presentation

of a lecture, or in conversation in which the speaker is deliberately formulating the expression of his ideas as he speaks. On the other hand, for a disc jockey on commercial radio the rate is usually higher.

The average rate of production of speech may be taken as 150 words per minute. This may be compared with the average silent reading rate of first year college students of approximately 225 words per minute (N. Thompson, private communication). That is, college students can read continuous prose faster than it is normally spoken. It is also evident from introspection that human beings can think faster than they normally speak, for example, while speaking one sentence, it is possible to think of and choose between several ways of phrasing the next sentence in a speech and, while listening to a speech, it is possible to think of several other topics and still follow the thread of the speaker's argument. These observations point to the potential usefulness of compressed speech in increasing the word-rate of listening to rates comparable with that of silent reading.

Trained speakers are able to maintain word rates as high as 225 words per minute for extended periods (Miron and Brown, 1968). Following extensive rehearsal of a short passage rates as high as 300 words per minute have been attained (Goldstein, 1940). However, speaking at faster rates than normal introduces undesired changes in vocal inflexion and the relatively low maximum rate attainable by most speakers limits the usefulness of this method.

Speed changing method

It is very simple to change the word rate of recorded speech by playing it back at speeds faster or slower than that at which it was recorded. If an audio-tape of a speech passage is played back at twice the recording speed the passage will be presented in half the time taken for its original presentation; that is, the word rate will be doubled. However, since the frequencies of the reproduced sounds are proportional to the tape speed, the frequencies of all components of the voice signal will also be doubled and the overall pitch of the voice heard

by the listener will be one octave higher than the speaker's voice. This so-called 'Donald Duck effect' is not acceptable to the majority of listeners although moderate compression (of up to 25% increase in playback speed) may be tolerable.

Expanded speech may be produced by playing a tape at a speed slower than that at which it was recorded. This procedure lowers the frequency of the voice signal producing an expanded speech which is not acceptable to the majority of listeners.

Sampling method

It is evident from experiments conducted by Miller and Licklider (1950) that a large portion of a speech signal could be discarded (that is, replaced by silence) without seriously affecting listerners' ability to recognize the words presented to them. This was shown by using a switching device which periodically turned off the speech signal. It was found that provided the switching occurred more rapidly than ten times per second the interrupted speech was readily understood. Listeners were able to identify correctly 90 per cent of the words used in the experiment even when half the speech signal was discarded.

Garvey (1953b) reasoned that since up to half of the speech signal could be replaced by short periods of silence between successive speech samples without greatly reducing the intelligibility, it should be possible to discard these unheard portions of the speech signal altogether. He did this using a cut-and-splice technique in which he cut the audiotape into small segments, discarded each alternate segment and then spliced the remaining segments together again. The resulting tape was then played at normal speed. Since the shortened tape was played at the same speed at which it had been recorded there was no pitch change, but because portion of the tape had been discarded it took less time to hear a given speech passage. He found that this time-compressed speech was intelligible, but his cut-and-splice technique was too tedious for general use.

Fairbanks, Everitt and Jaeger (1954) described a tape playback machine which employed a rotating playback head assembly to reproduce samples of a recorded tape. The unreproduced segments were brief enough so that no discarded sample contained a whole speech sound and the reproduced samples occurred abutted in time, that is, without silence or overlap between successive samples. Every speech sound in the original recording was sampled to produce compressed speech in which the original vocal pitch was unchanged. The same machine could produce expanded speech by periodically repeating samples of the recording. The cost and technical complexity of this and similar machines at first restricted the use of compressed and expanded speech to laboratory experimentation.

Several machines employing different techniques for accomplishing compression were available by the early 1970's. These included the VOCOM I which is no longer being produced, but which is of interest because it employed selective sampling rather than the periodic sampling used in all other machines. This compressor could be set to eliminate the unfilled intervals (pauses) which occur naturally in fluent speech. Since pause time constitutes up to approximately 50 per cent of the total time of any given speech passage considerable compression could be achieved without altering the words at all (Goldman-Eisler, 1968). Further compression could be achieved by setting the machine so that it reduced the duration of vowel sounds. Expanded speech could be produced on this machine by increasing the duration of the naturally occurring pauses.

Computers have been used to compress speech according to various sampling rules. In the technique employed by Scott (1966) the speech waveform was first converted into digital form and stored on digital magnetic tape samples at 20,000 times per second. Segments of the waveform were then discarded according to one of many possible sampling rules. Finally, the digital samples were reconstructed into an analogue speech signal.

Electro-mechanical compressors of the Fairbanks type discard segments periodically regardless of the information content of the segments being discarded. The computer could be programmed to discard segments selectively so as to retain maximum intelligibility of the compressed speech output. However, the cost and complexity of this technique have limited its application to laboratory experimentation.

The VARISPEECH machine (Varispeech) is a cassette recorder incorporating a small special-purpose computer which compresses the speech signal by converting it to digital form and discarding segments according to a periodic sampling rule.

The development which is likely to have the greatest significance for the future widespread availability of low cost speech compressor/expanders is the production by the Cambridge Research and Development Group of a Variable Speech Control (VSC) module (Schiffman, 1974). This small module and a variable speed motor and control built into an otherwise standard open reel or cassette recorder permit the listener to adjust the playback speed to give expansion/compression within the range 0.5 to 3 times normal word rate. Licences to incorporate VSC into equipment which they manufacture have been taken out by Sony, Matsushita, Hitachi and Magnetic Video Corporation (U.S.A.), but only the latter have begun marketing VSC machines. The Cambridge Research and Development Group is offering a cassette recorder containing the VSC module, and the American Printing House for the Blind also markets a similar machine which is available only to blind persons or to institutions serving blind persons.

RESEARCH

Intelligibility and Comprehension

Two general approaches have been employed in the evaluation of compressed speech. The ability of listeners to repeat accurately single words or brief phrases has been taken as a measure of the intelligibility

of the compressed speech. The other approach has been the listening comprehension test in which the listeners hear a continuous speech passage compressed to a given word rate and are then tested on their ability to answer questions on the facts and implications of that passage. These two general approaches (and variant forms not considered here) make different demands on the listener and, not surprisingly, have yielded somewhat different results. However, there does appear to be a consistent finding that intelligibility declines less rapidly with greater degree of compression than does comprehension. In other words, increasing the degree of compression has a smaller influence on intelligibility than on comprehension (Foulke and Sticht, 1969).

Intelligibility

Various characteristics of the stimulus material and of the listener have been shown to have effects on the intelligibility of compressed speech.

Method of compression

The intelligibility of compressed words has been shown to be influenced by the method of compression employed. Compression by the speed changing method results in a loss of intelligibility of approximately 40 per cent when the test words are compressed so that they are heard in only two-thirds of the time required for their production (Garvey, 1953b). Compression by the sampling method is reported as having a smaller effect on intelligibility. Garvey found only a 10 per cent loss in intelligibility when words were compressed by the sampling method so as to be reproduced in only 40 per cent of their original production time. Even when the words were reproduced in only 25 per cent of their original production time they were still 50 per cent intelligible. Fairbanks and Kodman (1957) reported a substantial loss in intelligibility when the discard interval exceeded 80 millisecond. (The VSC module uses a discard interval of approximately 30 millisecond.)

Linguistic factors

Compression by the speed changing method degrades the intelligibility

of vowel sounds more than consonant sounds, whereas compression by the sampling method degrades the intelligibility of consonants more than vowels (Kurtzrock, 1957). Klumpp and Webster (1961), using the speed changing method, found that short phrases were more intelligible than single words. This is probably explicable by the increased number of cues available to the listener due to the redundancy provided by context and sequence effects in short phrases.

Prior experience of the listener

Garvey (1953a), using words compressed by the sampling method, found that repeated hearing of such words improved their intelligibility. Henry (1966) found that words which have greater frequency of occurrence in the language, according to the Thorndike and Lorge (1944) word count, were more intelligible.

Comprehension

It has been found that several stimulus factors and several factors relating to the listener have effects on the comprehension of compressed speech. It is also evident that the comprehension of connected discourse is influenced by the intelligibility of the individual words of which that discourse is composed. Thus factors affecting intelligibility have effects on comprehension as well.

Degree of compression

Fairbanks, Guttman and Miron (1957) found comprehension of listening selections to be virtually unchanged when the selections were presented at 141, 201 and 282 words per minute. For higher word rates the scores on the test questions declined from 58 per cent correct at 282 words per minute to a near chance level of 26 per cent at 470 words per minute. Foulke and Sticht (1967) found a six per cent loss in comprehension between 225 and 325 words per minute and a 14 per cent loss between 325 and 425 words per minute. These and other studies not cited here suggest that comprehension declines only slightly as word rate is increased to approximately 275 words per minute but that comprehension declines more steeply as the word rate is increased still

further.

Account may be taken of the trade-off between slightly lowered comprehension test scores and saving in listening time by calculating an index of learning efficiency defined as the comprehension score divided by the time required to hear the speech passage. Using this index Fairbanks, Guttman and Miron (1957) found that learning efficiency increased as word rate was increased until a word rate of approximately 280 words per minute was reached. This finding has been confirmed by later experimenters. (Enc and Stolurow (1960), Foulke, Amster and Nolan and Bixler (1962)). The retention of material presented as compressed speech has been shown to be unaffected by the word rate at which it was originally heard by the listener (e.g. Foulke, 1966).

Method of compression

No consistent superiority of the sampling method over the speed changing method of compression has been shown in tests of comprehension of a listening selection (Foulke and Sticht, 1969). For tests of intelligibility it was noted above that the sampling method was superior. This indicates that the comprehension of connected discourse presented in compressed form involves more than merely the intelligibility of the individual words of which the passage is composed.

Listener variables

No differences between male and female listeners in listening comprehension scores have been found over a wide range of word rates (Foulke and Sticht, 1967). A positive relationship has been demonstrated for adult subjects between intelligence of the listener and his or her ability to comprehend compressed speech (Fairbanks, Guttman and Miron, 1957). A positive relationship has also been demonstrated for school-age children between age-grade level and the ability to comprehend compressed speech (Foulke and Sticht, 1969). In an experiment in which 90 children, 30 from each of first, third and fifth grades responded individually to 50 short imperative sentences presented at one of ten word rates ranging from 175 words per minute to 400 words

per minute, Wood (1965) found that the effect of rate of presentation and of grade level on comprehension scores were statistically significant. Comprehension scores generally increased with increasing grade level and decreased with increasing word rate. No relationship was demonstrated between intelligence and comprehension scores.

Orr, Friedman and Williams (1965) reported finding a significant correlation between the reading rate of listeners and their ability to comprehend compressed speech. Various experimenters have attempted to improve the comprehension of compressed speech passages by means of training programs giving extensive practice in listening to compressed speech at various word rates and with or without interspersed questions. No training program was effective in increasing the comprehension test scores of the listeners (Reported by Foulke and Sticht, 1969).

Applications of Rate-controlled Speech

Advertising publicity for commercially available speech compressors has emphasised that the compressor allows the user "to listen the way he reads - always at his optimum word rate" (Varispeech). It is claimed that the compressor provides freedom to self-pace individual listening, to scan or "speed listen" to those parts of a recording which are of little interest or which are already understood, and to listen more slowly to more demanding material. The time saving made possible by the use of compressed speech playback of recordings for review purposes has also been emphasised. For recreational reading and for educational purposes compressed speech offers to blind persons the opportunity to read by listening at word rates comparable with the normal reading rates of sighted persons.

Where students have been provided with compressed speech recordings in audio-tutorial learning situations, it has been claimed that they listen more attentively and that the time saved can be used for other studies. It has also been claimed that students can concentrate more fully on lectures if they have the assurance that a compressed copy of

the lecture will be available for later review purposes (Boyle, 1971).

In an experiment reported by Short (1975) a semester-long college course which had for some years previously been taught by self-paced audiovisual methods was presented to a randomly chosen half of the enrolled students (total enrolment was 90 students) by means of variable speed compressors. The other students listened to identical recordings from normal speed tape recorders. It was found that of those students assigned to use the compressors, 70 per cent "quickly adapted to, and liked, listening at faster than normal rates". Forty per cent of these students regularly listened at word rates in the range 267-320 words per minute. (The normal word rate for the uncompressed tapes was 150-160 words per minute.) The group of students who used the compressors saved significant amounts of time and gained significantly higher scores on the achievement tests included in the course.

In another experiment with college students, Challis (1975) randomly assigned the 96 students to one of four groups, each of which listened to 16 units of a required course presented in audiovisual form. The groups were assigned different compressed versions of the audiotapes as follows: 1. normal rate (120 words per minute); 2. thirty per cent compression (174 words per minute); 3. forty per cent compression (200 words per minute); 4. choice of tapes compressed to 20, 25, 30, 40, 50 and 55 per cent compression. Contrary to the findings reported by Short (1975), no significant difference in achievement was detected between the four groups. However, in response to an affective questionnaire, almost all students expressed favourable attitudes towards compressed speech and also felt that control by the learner of the compression rate was necessary or desirable for most satisfactory learning.

It appears from these reports that beneficial applications of compressed speech are likely to be found wherever suitably motivated listeners desire to improve their learning efficiency by controlling the speed of presentation of recorded speech according to the difficulty

of the subject matter.

Another area in which compressed speech may be useful is in the improvement of reading skills. Winters (1975) reported that seventh grade students with reading problems understood significantly more of the content of a given passage presented through compressed speech recordings than did similar students who read the same passage. She claimed that practice in listening to compressed speech could be used to improve the reading comprehension of children with learning disabilities.

Thames and Rossiter (1962) reported an experiment in which compressed speech was used as a pacing device to increase reading rate; the reader was encouraged to read at a given rate while listening to the compressed speech recording of the reading passage. Forty-six students aged 13 to 15 years were tested for reading rate, reading comprehension and listening comprehension, both before and after taking part in a training regime. The training regime comprised one 30 minute period in each school day over a ten day period. One group of students (the control group) merely read one of 10 short stories during each period. The experimental group read the selected short story while listening to a compressed speech recording of the story. The word rate of the recordings was 150 words per minute on each of the first two days and was then increased in 50 word per minute increments every second day to the maximum rate of 350 words per minute which was used on the last two days. Adequate motivation of both groups was ensured by administering a short comprehension test after each practice period. It was found that the reading rate of the experimental group increased significantly without any loss in comprehension. When tested again nine months later, the experimental group was still superior in reading rate. No differences in listening comprehension were found to be associated with the experimental treatment.

Stroud (1971) has reported a study in which compressed speech versions of imperative and interrogative sentences were presented to two groups of second grade children. One group of children had normal speech

and the other group had been diagnosed by a speech clinician as having functional misarticulations. It was found that the children with functional misarticulations had greater difficulty in comprehending rapid speech. At word rates greater than 293 words per minute they made significantly more errors than did the normal speaking children. Stroud claims that these findings "have many implications relative to the processing of information by children with functional misarticulations".

Expanded speech has been used in listening comprehension exercises in the teaching of a foreign language. Flaherty (1975) reported an experiment in which 226 high school students in second year French classes were randomly assigned to one of three experimental groups. All students were required to answer the 60 questions (multiple choice format) in the French Aural Comprehension Test. Questions in this test are of two types, completion and rejoinder. Students answered these listening comprehension questions by selecting the appropriate answers from suggested oral completions and from printed English rejoinders. The questions were presented to one group at the normal speaking rate of a native speaker of French. The other two groups heard the same recording after it had been expanded to 135 per cent and 170 per cent respectively of its original recording time. It was found that the differences between the mean scores of the three groups for the rejoinder questions were not significant. On completion of the exercise, however, both the expanded speech groups obtained significantly higher mean scores than did the normal speech group. The 170 per cent group had a slight but non-significant advantage over the 135 per cent group.

In summarizing a series of studies using rate controlled speech with mentally retarded, language impaired, reading disordered and normal first grade children, McCroskey and Nelson (1975) reported that rate of speaking was a significant factor in the understanding of simple-active-affirmative-declarative sentences by language impaired children and by children within a normal classroom who had been referred for

special reading. For normal children aged six to nine years (N= 360) it was found that comprehension was influenced by age, difficulty of the test sentences and by the word rate used in the presentation of the test sentences. Mentally retarded children (N= 23) aged seven to ten years showed higher comprehension when the sentences were presented as expanded rather than as compressed speech. Normal first graders aged six and seven years (N= 20) were better able to imitate nonsense syllables when these were presented under expanded conditions.

Similar effects of rate of speaking were obtained by Berry and Erickson (1973) in listening comprehension tests administered to kindergarten and second grade children, that is, comprehension was higher at slower rates.

A comprehensive summary of all aspects of rate-controlled speech including research into its applications has been provided by Duker (1974). An entire issue of the Journal of Communication, Volume 18, No. 3, 1968, was devoted to compressed speech.

As is evident from the examples considered above, there are many potentially beneficial applications of rate-controlled speech. The wider use of rate-controlled speech by educators and students appears to be dependent on the availability of simple and inexpensive cassette tape compressor/expanders. The technical means required are already available but the major manufacturers appear to be waiting on the development of a sufficiently large market before moving into production.

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EDUCATIONAL TECHNOLOGY: A DISCUSSION OF SELECTED JOURNAL LITERATURE 1976 - 1977

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Abstract

The recent literature of educational technology has, in general, been concerned with theoretical issues, practices and procedures and with evaluation. An emphasis on basic concepts and a stock-taking of practices is an apparent theme in much of the literature discussed. Evidence suggests that educational technologists ought to be less free in their adaptation of other disciplines and instead work from the more solid base of practice.

Introduction

The approach taken in this review is to survey major professional journals in educational technology (and to a lesser extent some fringe discipline journals) and to make a grouping of articles into perceived themes. In this way, it is hoped to be able to review some current issues which form the 'cutting edge' of the study of educational technology.

The identified themes are structured under three broad headings - firstly, those which concern basic theoretical issues, secondly, the grouping centred upon practices and procedures and, thirdly, those offerings associated with evaluation

Theme 1: theoretical issues

The identified topics of the first area are the structure of educational technology, media selection, imagery, and educational technology in curriculum development. It is significant that the 'systems' emphasis is absent from the professional journals. Instead, Hawkridge (1976) provides a valuable historical review of the development of the subject area centred around what he terms 'artefacts' (or essential documents) which are representative of the different traditions or schools of thought which have brought the study to its present position. A further essential article which analyses structure is provided by Aagaard (1976) in which he clearly details the notions of instructional science and instructional technology. An instructional technology, he contends, is "... in addition to being rooted on the one hand to a scientific discipline capable of developing operative rules ... (it) must, on the other hand, be rooted in a philosophy of education whence it can derive its normative rules for where and whether to apply the scientific results". He further outlines what he terms the 'micro' and 'macro' dimensions of instructional technology. Proponents of the micro dimension are chiefly interested in psychology of learning, perception, information, and motivation studies, while the macro dimension, drawing from studies in applied teaching sociology, economics, cybernetics, and organisation theory, is concerned with systems analysis, network planning, cost-effectiveness studies, multi-media systems, and educational modules.

Perhaps one of the most fundamental points that Aagaard makes is that "... unless technology of instruction is to become a case of fools rushing in, it is important that it be integrated in a philosophically based educational debate on one hand and, on the other, founded in a manifold science of instruction". An example of a philosophical critique of educational technology in practice is found in Harris and Holmes' (1976) article on the Open University.

The next three topics are concerned with theoretical issues and provide examples of a 'taking stock' and a review of fundamentals. Heidt (1977), for example, has continued his work on media taxonomies and, after an initial review published in the British Journal of Educational Technology, has explored fundamental problems associated with media-learner operations. The article rejects previous simplistic approaches and breaks new ground in unearthing different conceptual analyses to the problem of taxonomies. Thus Heidt suggests that educational technologists ought to be "... focussing on the process of the acquisition of knowledge instead of on the informational content only, and taking the intellectual skills or operations which are connected with the acquisition of a specific kind of information as a starting point for the classification of media". Gropper (1976) likewise feels the need to return to basics, even to the extent of clarification of the term 'medium'. The distinction between that which is mediated and that which does the mediating is seen as essential to an effective media selection scheme.

Another 'taking stock' review article is that provided by Fleming (1977) who asserts that "... the way in which pictorial stimuli influence thought and memory processes is becoming an increasingly *pivotal* issue in the media field". He points to the fact that recent research has given rise to several different theories concerning pictorial information processing and the role of imagery in cognition. Such theories appear to hold conflicting implications for the design of instructional materials. Unfortunately, Fleming is content to hint at consequent difficulties for instructional designers and does not consider the more weighty issues involved in attempting to resolve practical problems.

The topic concerned with curriculum poses the hoary problems associated with the notion of a rational curriculum and objectives. The paper by Shaw (1976) exposes the rational (systems, or objectives) curriculum model as an expository device. As a formalised description it has compelling qualities of clarity, simplicity, and articulation, but he

contends it is not the description of a real activity. To Shaw, curriculum is essentially an area of "renewals or advances of commonly accepted traditions of thought and work" and that participation in both curriculum planning and implementation is a political activity. In essence, Shaw is denying the linear systems approach which underlies much of the literature of educational technology. Pratt (1977) likewise outlines the essential differences in style between the behavioural and humanistic positions. For the educational technologist, Pratt would advise that the setting of intentions and the measurement of achievements be kept distinct and, further, that it should be recognised that "intents are always to develop states rather than behaviours". To Pratt, education never aims to produce single behaviours only. Instead, "most of the states which education and training seek to develop are *continuing* states. Such states in the learner are formed through the integration of many related behaviours with such observed behaviours sufficing as indicators that the state has been achieved". Educational technologists should therefore make attempts to detail procedures which relate to such states and not merely dismiss curriculum concepts that are loosely framed or non-behavioural.

Theme 2: practices and procedures in educational technology

The second major division of themes relates to the area of practices and procedures in educational technology. A 'taking stock' approach is clearly evident in this literature also. Practices and procedures which have received attention include the design of instruction, methods and media.

In the design of instruction, the following practices have been considered: pre-instructional strategies, individualized instruction and the sequencing of content. Four pre-instructional strategies considered by Hartley and Davies (1976) in their review are pre-tests, behavioural objectives, overviews, and advance organisers. They find that these strategies are not always advantageous for learners but

that they are most likely to be useful in situations calling for meaningful rather than rote learning.

One variety of individualized instruction that has attracted considerable attention in the literature is the Keller Plan or Personalized System of Instruction. Robin (1976) has reviewed research in this area (which he calls 'behavioural instruction') and a whole issue of Programmed Learning and Educational Technology has been devoted to it (Vol. 13, No. 1). The Keller Plan was originally devised for courses at the tertiary level. According to Romiszowski (1976), the significance of the Keller Plan is that :

(i) it is the first system of individualized instruction to successfully enter the mass implementation stage; and

(ii) in its purest forms it is the closest practical application of principles of learning derived from laboratory work in psychology.

Educational technologists are frequently concerned with the sequencing of instructional content (a concern having its origin in the design of programmed instruction materials). Posner and Strike (1976) contend that there is little evidence on the consequences of alternative content sequences and they consider instead the different alternatives within their categorization scheme of sequencing.

Methods attracting attention include microteaching, games and simulations. A 'second-wave' of microteaching articles form the first topic in this section. Perrott's articles investigate the effects of *self-instructional* microteaching courses (Perrott, 19?6 and Perrott, et al, 1976). Provision for self-evaluation eliminates the most expensive and least feasible aspect of the Stanford model: the time-consuming one-to-one relationship between instructor and student which is required to implement the Stanford model cannot work with the times and class sizes normally involved. The research detailed by Perrott suggests that self-instructional and self evaluative microteaching

could be a particularly valuable technique for use with in-service teachers. Ely's (1976) paper on educational media and microteaching serves as an important introduction to the role of media in microteaching.

The second focus in this section relates to the topic of games and simulations to which a special theme issue of Programmed Learning and Educational Technology is devoted (Vol. 3, No. 3). The Cruickshank and Mager (1976) article reviews the field, noting that "although there is a body of knowledge about instructional simulation and games, it certainly is not organised and, consequently, it has not resulted in improved communications or investigations". This article, however, only hints at the major problems of the field and progresses little beyond the old Dale cone in a structural classification.

Media and technology in education have been reviewed by Salomon and Clark (1977). They conclude that the yield of media research in terms of understanding media, guiding its use, and improving education is disappointingly small. Perhaps it is a reflection of the prevailing economic climate that the medium which is receiving as much attention as any other in the literature of the field is print. A comprehensive review of research in the use of prose, tables, charts, illustrations, etc. to present technical information appeared in Instructional Science 6, 1977. Interest in this medium is also reflected in the Hartley, et al, articles in Programmed Learning and Educational Technology (1976, 1977).

Theme 3: educational technology and evaluation

The final section represents a concerted attack upon a major problem - that of the evaluation of educational practice. Rowntree (1976), for example, states that he is "clearly not the only one to sense evaluation emerging as the unifying concept in educational technology". The swing towards this notion is explained in terms of an interesting analogy with science. As Rowntree notes, "... the contribution of

scientific method is to *evaluate* the hypotheses which have arisen outside of it. So it may be with educational technology".

Thus educational technologists should stop trading on prescription (and hence design). The true worth of educational technology, according to Rowntree, is in the description, explanation, and evaluation of potentialities and effects *after* the design possibilities have been thrown up from 'external' sources.

The implementation of Rowntree's position is illustrated by several significant articles concerned with both the art and science of evaluation. Henderson and Nathenson (1976), face the problems associated with developmental testing and provide a useful description of the art as it is applied to a course at the Open University. David Nevo (1977) also presents an applied model for the utilisation of formative evaluation in the process of developing instructional materials giving special attention to the structural implications of adopting such an evaluation model. The paper by Herbig (1976) explores criterion referenced item testing and outlines a number of useful measures. The advantage of the pre-test/post-test procedures for evaluating item suitability are given and the meanings associated with various coefficients are outlined.

On the same theme of evaluation it is interesting to note the return of a comparison study in which the acceptability of mass section multi-media instruction is compared with the ideal class and three other teaching formats (Cunningham, et al, 1976). This study is interesting in that it employs a test instrument made up of 25 semantic differential adjectives which are used to identify six factors (general image, worthwhileness, formality, evaluation, performance and communication). These factors are taken to describe teaching methods. The discussion reports that the "... results of the research clearly seem to indicate that large mass sections using a multi-media format appeal to undergraduate students". This is reported to be in direct contrast to past references in the literature which state that

although students may do well in objective tests, they do not like taking large mass section courses.

Conclusions and implications

Recent work concerned with the theoretical issues of educational technology shows a retreat from the simplistic value laden propaganda which exhorted the use of audio-visual aids in education. The field is now characterized by a fragmentation of opinion and confusion over what constitutes the fundamentals of the area. Rowntree, for example, highlights the unsatisfactory nature of theoretical debate and proposes a revolutionary solution to the problems associated with curriculum and materials design. Educational technologists, he contends, should abandon the continued attempts at prescriptive theories and recognize the central importance of descriptive and evaluative studies as tools for design improvement. Fleming, on the other hand, still writes from the position that a derivative relationship should exist between theory and instructional design practices.

In the search for the 'right start', educational technologists have turned into many blind alleys. As a personal opinion, it would seem to us that the bastardization of other disciplines has been less than fruitful. The much heralded synthesis of other educational studies into a *central* discipline of educational technology has not eventuated.

The all too catholic concern for adapting *other* discipline studies should be stemmed. Perhaps educational technologists should limit their vision to special closed systems and, within such systems, work from the solid base of practices.

The first step would be the description of practices within such closed systems and would feature both normative and operational aspects. Arising from these descriptions the educational technologist would attempt to assess the nature of the system and monitor its use.

This approach has certain parallels with that employed at the Open University; one example is described by Henderson and Nathenson (1976) in course improvement of the 'Elements of Music' offering at the Open University.

Educational technologists should, therefore, take seriously the notion that their art is defined in terms of practice. The hasty attempts for justification of procedures by the borrowing of status from existing disciplines has been of little benefit in developing a unique contribution to the problems of education.

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EDUCATIONAL TELEVISION SYSTEMS : A GUIDE

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Abstract

Television systems for educational purposes can cost from about $1,500 upward. Systems can be used for a diversity of educational purposes including relaying pictures from one place to another, playback of (for example) a skills practice session and the production of high quality educational programmes in either colour or black and white.

Introduction

This guide is written for those people interested in purchasing television production equipment or extending the range of existing equipment facilities. Most of the equipment listed in the guide will not meet broadcast television standards. However, the equipment (referred to as closed circuit television equipment (CCTV)) will deliver the same picture quality as would be expected from normal home reception of broadcast transmission.

There are some six to seven hundred video recorders (which includes open reel, cassette and cartridge types) in South Australian schools and tertiary institutions. There are also some fifteen to twenty different types of educational television studios. These vary from simple monochrome (black and white) studios to more complex colour studios. These studios are producing an increasing proportion of the programmes now used in educational institutions.

The approach taken in this guide is to list a number of alternative systems, show their costs, and nominate some possible educational applications. The alternative systems costs shown in the tables are current and are, of course, subject to changes due to inflation. Equipment is of Australian CCCIR standard for black and white and PAL for colour.

Monochrome systems

Five different monochrome systems are listed in the tables.

System Number 1

The first system shown is the basic reel-to-reel video tape recorder, a video camera, tripod, receiver/monitor and accessories. The video tape recorder will record and play 180mm diameter tapes(which give up to seventy minutes playing time) and 130mm diameter tapes for thirty minutes. The video recorder will record off-air programmes when used with a suitable receiver/monitor and has a video input for dubbing from another recorder. The camera for system one does not necessarily need a viewfinder. The accessories include a general purpose microphone and a microphone stand. The need for lights in some classrooms is desirable (but not essential) to ensure reasonable picture quality.

Table 1

Black and white system number 1 equipment	Cost (1977)
Black and white video camera	341
Video tape recorder	625
Television receiver/monitor	215
Microphone	8
Microphone stand	8
Light and stand	150
Video and audio lead	30
Power cable (retractable)	20
1 Tripod	55
Total cost	$1,452

A long video lead allows the camera to be moved a considerable distance from the video recorder. Also, a long power cable is needed. The one priced in Table 1 (the retractable type) is easily stored and safe to use. The tripod needs to be light and sturdy with reasonably smooth pan and tilt movements. The educational applications for this system include microteaching, recording events, demonstration of equipment, apparatus, copying film to video, low level teaching tapes and off-air recording.

System Number 2

An alternative basic system is the 'port-a-pac' or portable video recorder. The camera and portable video recorder (which can be carried by one person) uses internal batteries. The camera has a viewfinder that doubles as a monitor to play back recorded material. Broadcast programmes, from a suitable receiver/monitor, can be recorded with this video recorder. The recorder can be used on three sources of power: internal battery, car battery and by using the power adapter (which also serves as the battery charger) from a normal power supply. The tripod can be the same as for the first system. Accessories are also the same as for the first system.

The port-a-pac video recorder has a 130mm spool reel and its play/record time is from 30 minutes to 38 minutes, depending on the exact length of the tape. It is important to note that the larger (180mm) reels of tape cannot be used with this equipment.

Educational applications for this system are similar to the first except that the video tape recorder can be used outside in the field and the viewfinder is used for a monitor to check recorded programmes. Low level teaching tapes can be produced with ease, giving reasonable continuity by using the 'in camera' edit facility.

Table 2

Black and white system number 2 equipment	Cost (1977)
Port-a-pac) Camera) Video tape recorder) Power pack (battery charger)) r-f adaptor (inclusive)) Video tape recorder/monitor) lead)	1,223
Television receiver/monitor	215
Accessories (same as for black and white system number 1)	271
Total cost	$1,709

System number 3

System three is for use with system one, and combines it with an edit video recorder and an additional monitor. This allows the portable video recorder to record events outside the editing room. The recorded material can then be played back into the editing video recorder and a 'master' tape produced.

The edit video recorder can assemble and insert both picture and sound onto a master tape. A pre-planned shooting script is necessary for this kind of work.

System three has similar educational applications as system one and system two. Improved edits add to picture quality and, if carefully planned and executed, this system can be used to produce reasonable quality teaching tapes. The post-dubbing of sound and editing of the picture creates a wider scope for modification to programmes after evaluation of content has taken place.

Table 3

Black and white system number 3 equipment	Cost (1977)
Combining system No. 1 (port-a-pac) with an edit video tape recorder	1,709
Additional receiver/monitor	215
Tripod, dolly and pan tilt head	411
	$2,335

System number 4

The fourth system includes two black and white cameras with viewfinders, a portable video switcher for the selection of cameras, a portable sound mixer to select sound sources, three black and white monitors (2 for previewing cameras and one for checking the transmission to a video recorder), and two extra microphones for use (for example) with group work. The power cables can be used in conjunction with multiple general power output boxes which are tidier and safer. This system requires more floor space and, because of this, additional lights and stands are needed.

The black and white video tape recorder does not necessarily need to be an edit master, but if it is, it will enable recordings to be edited on the spot. System four (which is a low-level portable studio) enables equipment to be moved into drama halls, small theatres and classrooms to record a variety of events. There is a company that builds a compact 'portable studio' unit that incorporates all the equipment listed. This unit is small enough to move, but needs two people to carry it.

The additional features of this system extends the range of educational applications to better quality recordings of plays, demonstrations (pottery, weaving, painting methods in workshops, etc.) on location, using studio techniques.

Table 4

Black and white system number 4 equipment	Cost (1977)
2 black and white video cameras with viewfinders	2,160
1 portable video switcher	250
1 portable sound mixer	20
3 black and white monitors	745
3 microphones and stands	50
3 lights and stands	450
1 power lead retractable	20
2-4 general power outlet boxes	30
6 video leads (uhf connectors)) 3 audio leads)	40
1 master edit video tape recorder	965
Total cost	$4,730

System number 5

System 5 is a multi-camera studio with three black and white studio cameras. It features a video switcher that has special effects, internal keying for titles and four small black and white monitors (3 for previewing cameras and one for transmission to a master video recorder). The master edit video recorder has the facilities described in the other systems. The sound mixer will need line and microphone inputs so that a sound tape recorder with pre-recorded music or sound can be integrated into the programme during the recording.

The lighting grid is a permanent structure and should be flexible enough to light areas all over the studio floor.

Microphone and video outlets can be connected to the skirting of the studio. Tripods and dollies will have to be stronger with smoother movement for free transitions and tilting. A console to house the equipment (which could be on castors for mobility) would cost about $1,000.

A studio of this type will produce high quality educational programmes.

Table 5

Black and white system number 5 equipment	Cost (1977)
3 black and white studio cameras talkback, tally lights and viewfinder	3,240
1 special effects video switcher	768
1 master edit video tape recorder	965
4 video monitors in a bank	880
1 multiple input sound mixer	600
1 sound reel-to-reel or cassette recorder	267
1 lighting grid and lights	620
Microphone and video outlets on the studio skirting floor	50
3 tripods and dolleys	420
1 prefabricated console to house the studio equipment	1,000
Total cost	$8,810

Colour systems

There are five colour systems listed in the tables.

System number 6

The cost of this system will be about three times that of the basic black and white system (number 1). Major differences are the need for more lights and a colour monitor, camera and recorder. Educational applications are similar, but the extra lighting equipment required may become obtrusive and could detract from the intended purposes of the equipment.

Table 6

Colour system number 6 equipment	Cost (1977)
1 colour camera (camera control unit)	4,500
1 video cassette recorder	975
1 colour receiver/monitor	776
2 lights and 2 stands	300
1 microphone and stand	16
1 video cable (uhf connectors)	10

Colour system number 6 equipment (contd.)

1 sound cable (connectors to be selected)	10
1 tripod	55
Total cost	$6,642

System number 7

This system gives the choice of using either open reel recorders or the 3/4" UMatic video cassette recorders. The open reel recorder is lighter and existing ½" video tapes can be used. The 3/4" UMatic is heavier and has a recording time of only 20 minutes on cassettes. However, they are very easily loaded and the tape is kept clean inside the cassette.

An alternative basic colour system can be built up around battery operated portable equipment. This system is considerably heavier than the comparable black and white system.

Table 7

Colour system number 7 equipment	Cost (1977)
Port-a-pac (camera and camera control unit) Video cassette recorder) AC adapter (battery charger)) All connecting leads)	5,280
Accessories for above colour system	1,167
Total cost	$6,447

Alternative system 7

Colour reel-to-reel video tape recorder) (Port-a-pac)) AC adapter (battery charger) All connecting leads)	4,080
Accessories for above colour system	1,167
Total cost	$5,247

System number 8

This system is similar to system number 3 for black and white. The edit video cassette recorder allows for higher quality production. Outside or remote recordings may be recorded onto the portable equipment and then brought back to the editing room where the programme may be edited according to a pre-determined script.

Table 8

Colour system number 8 equipment	Cost (1977)
Combining systems 6 and 7 with an	6,447
Edit video cassette recorder	4,500
1 colour receiver/monitor	776
	$11,723

System number 9

This colour system combines systems 6 and 8. It needs an additional monitor and a portable colour switcher. Extra lights and microphones are needed to cover more area when recording. Tripods, dollies and cameras are expensive and a choice between two tube cameras and three tube cameras depends on the amount of money available and the educational purposes of the system. The technical colour quality of this system is generally not as good as that obtained from home reception of broadcast programmes.

Table 9

Colour system number 9 equipment	Cost (1977)
Same equipment as for system number 8	11,723
1 colour receiver/monitor	776
1 Portable switcher (colour)	1,600
2 lights and 2 stands (using quartz iodide lamps)	300
2 microphones and 2 stands	64
1 tripod dolley	150
1 colour camera	4,500
Sound and video cables, plugs and sockets	80
	$19,193

System number 10: low level multi-colour camera studio

This system is expensive. Very careful examination of educational purposes is required. In the costing of this system, minimum costs are shown and these will vary depending on the technical quality of cameras. The cameras priced are professional 3 tube units which have a resolution of more than 500 lines. The cameras should have a viewfinder, tally lights and intercom (basically the same features as the black and white system number 5).

The lighting grid needs to be light in construction, easily accessible and moveable and will require quartz iodide lamps that have colour temperatures of between 3,300° and 3,600° Kelvin.

The four black and white monitors in the console are for previewing cameras and monitoring the telecine chain. The video switcher needs to be a mixer and to have special effects. The camera, tripod and dollies need to be rugged (and to be able to be moved quickly when recording programmes).

The telecine chain allows film, slides or graphics to be integrated into the programme. This allows a third camera to be permanently set up in the video control room along with the programme input equipment. The

simple, but reliable systems shows that they are likely to be less intimidating to lecturers and teachers and, therefore, used more extensively. Ultimately, however, it is the intended educational application which should determine which system is desirable.

extra colour monitor shown in Table 10 is for play back or transmission to observe programmes out of the switcher. The other colour monitor is for checking the output from the master colour video cassette recorder.

A sound tape recorder or cassette recorder should be included in the console permanently for playing pre-recorded sound materials. Headsets are a vital link between the director and the cameramen and floor manager and are necessary with this system. The master colour video cassette recorder should have video insert edit and assemble video and also sound insert facilities for post dubbing and editing.

A console to house the equipment can be built in a modular format for adding on sections at later times.

Colour system number 10 equipment	Cost (1977)
3 colour cameras	24,000
3 tripods and dolleys	400
1 colour video switch	1,600
1 sound mixer	600
Lighting grid and 6 QI lights	900
3 microphones and 3 stands	180
1 tele-cine chain	1,250
4 black and white monitors (4 in a bank)	880
2 colour monitors	1,552
1 sound tape recorder	260
4 head sets	52
1 master edit machine VCR	4,500
Power cables, video leads, audio cables and plugs and sockets	90
Total cost	$38,264

Conclusion

Ten different television systems have been outlined. These systems have a wide range of educational applications. Experience with relatively